

26 ~~21~~ 81. An assembly is claimed in claim ~~21~~ <sup>25</sup> further comprising masses of solder connecting said terminals to said contact pads of said substrate.

27 ~~26~~ 82. An assembly is claimed in claim ~~26~~ <sup>24</sup> further comprising masses of solder connecting said terminals to said contact pads of said substrate.

#### REMARKS

The present communication is responsive to the Official Action mailed on October 27, 1995. The specification was objected to under 35 U.S.C. 112, first paragraph as assertedly failing to provide an adequate written description of the invention, whereas all of the presently pending claims (claims 1-6, 15-21, 36-38 and 61-80) were rejected under the same provision for the same reasons as set forth in the objection to the specification.

It is respectfully submitted that the matters referred to in the objection and rejection, are in fact, described in the specification.

The Official Action questions "where the disclosure discusses a semiconductor chip and a distinct flexible sheetlike element formed separate thereto" and states that the disclosure and drawings "provide the chip and flexible element as provided in combination..." However, as shown in figure 6, the "interposer" including the sheetlike flexible element is provided separately from the chip and then connected to the chips in a later operation to form the combination or final assembly including both the sheetlike flexible element and the chip. See the text from page 25, line 25 through page 26, line 5. Moreover, the application states that one aspect of the invention includes a "semiconductor chip assembly" which includes the sheetlike element with terminals thereon (see page 5, lines 19 et seq.) whereas another aspect of the invention is directed to "components for assembly to a semiconductor chip...", i.e. the component or sheetlike element with other related features such

as terminals thereon as a separate article of manufacture, before it is assembled to the chip. Thus, it is clear that the specification tells the skilled artisan that the component or sheetlike element with terminals and other features can be provided separately from the chip and then assembled thereto. It is also clear that Applicant regards as aspects of his invention both the component separate from the chip and the larger assembly made when one puts the component together with the chip. The claims in the present case include claims to the component standing alone (e.g., claim 15 and the claims dependent thereon) and claims to the assembly, including both the component and the chip (e.g., claim 1 and the claims dependent thereon).

As to whether the component must be "attached" to the chip in the completed assembly, in those claims directed to the assembly, the component is "attached" to the chip in the sense that the terminals on the sheetlike element are electrically connected to the contacts on the chip by the flexible leads. However, the specification makes it clear that the flexible sheet itself should be free to move relative to the chip. Thus, the specification notes that the terminals on the dielectric sheet or "interposer" should be movable relative to the contacts on the chip and relative to the contact ends of the leads to provide compensation for differential thermal expansion (see page 6, lines 12-15 and page 19, lines 9-21). The specification explicitly states that this action is enhanced by movement of the flexible sheet or "interposer" relative to the chip itself, i.e. "buckling and wrinkling of interposer 42" (page 20, lines 18-19) and thus instructs the reader that the sheet should be free to flex and move relative to the chip in the finished assembly. However, the specification also tells the reader that the flexible sheet carrying the terminals may be adhesively bound to the chip provided that the attachment still allows the sheet to move. For example, where the sheet is adhesively bound to the chip, but a compliant layer is provided in or under the sheet or

"top layer", the sheet or top layer "will remain flexible" even when it is adhesively attached to the chip. See page 41, lines 22-29. Thus, the sheet carrying the terminals need not be adhesively bound or "attached" to the chip, but may be so attached if desired.

The Official Action questions "where the movable terminal feature is disclosed in the disclosure." All of the passages cited above state the concept that the terminals should be movable with respect to the chip and with respect to the contacts of the chip so as to compensate for thermal expansion of elements in the system. Indeed, the specification notes, as a problem to be addressed by the invention, the difficulties posed by thermal expansion and contraction of semiconductor chips and the substrates to which the chips are mounted (page 2, lines 11 et seq.); mentions the movability of the terminals with respect to the chip (page 5, lines 30-31) and explains that the ability of the terminals to move with respect to the chip "provides compensation for differential thermal expansion of the chip and substrate." Indeed, the specification includes drawings (Figs. 2 and 3) which show the chip 28 and the contacts 40 on the chip connected to contact pads 24 of a substrate 20 by means of the flexible leads 50 and terminals 48 on the flexible sheet or interposer 42. As illustrated, the terminals 48 are firmly bound to the substrate by solder masses 52 (page 19, lines 16-26). However, because of the flexibility of the leads and sheet, the terminals 48 can move with respect to the chip contacts as specifically depicted in Fig. 3. See the depiction of lead 56a in broken line bent position illustrating relative motion of the chip contact and terminal. See also page 20, line 9 - page 21, line 5. This flexing and bending allows for differential expansion and contraction of the chip and substrate. Similar disclosures are provided with regard to other embodiments of the invention (e.g. page 38, line 25 - page 29, line 2 - page 41, lines 24-29). It is respectfully submitted that movability of

the terminals relative to the contacts on the chip in the assembly is taught throughout the specification.

The "securement elements" are referred to in the specification at page 9, line 34 through page 10, line 21; and at page 42, line 12 through page 43. These elements are illustrated in Figs. 16 and 17 of the drawing (reference numeral 8361). As explained in the specification (e.g., Fig. 15 and pages 39-40), certain embodiments utilize leads having contact portions or contact ends (854', Fig. 15) projecting outwardly beyond an edge of the interposer or flexible sheet so that these contact sections or contact ends can be engaged with the contacts on the chip. In certain embodiments, Applicant uses the securement elements (Figs. 16 and 17) to support the outwardly projecting ends. This assures that the contact ends of the leads will remain in place before they are attached to the chip, and will not be bent or otherwise displaced during handling or manufacturing. See the disclosure at page 42, lines 21 *et seq.* The securement element may be attached to or formed integrally with the remainder of the interposer or flexible sheet. The term "securement element" is used to denote this part of the structure. As used consistently throughout Applicants' specification and claims, the term "securement element" simply means an element which can support the contact portions of the leads. It is respectfully submitted that the specification clearly conveys to one skilled in the art what is meant by the term "securement element".

The allegation in the Official Action that the disclosure fails to discuss "a distinction between a movable lead and a flexible lead and if the movable lead and flexible lead are one in the same" is not understood. The disclosure and claims do not refer to leads as a whole as being "movable", but consistently refer to the leads as being flexible. In part because the leads are flexible, the terminals can be moved relative to the contact ends of the leads. For example, with reference to Fig. 3, lead 50a is flexible and hence terminal 48a

is movable with respect to contact 40a, and, the terminal 48a is also movable with respect to the contact end 56a of the lead that is bonded to the contact 40a. Of course, the opposite is also true; the contact end 56a is movable with respect to the terminal.

With regard to whether there is "a distinction between the layer of compressible material and [the] flexible sheetlike element and if so, where the distinctions are addressed in the disclosure" (Official Action sentence bridging pages 2-3) the following is noted. The "compliant compressible layer" may be included in the "flexible sheetlike dielectric interposer" as specified for example, at page 19, lines 10-16. Thus, the interposer "may incorporate one or more layers" and preferably includes "a compliant compressible layer..." Manifestly, if the interposer includes only one layer and includes a compliant compressible layer, the compliant compressible layer would constitute the entire interposer. However, in Applicants' preferred embodiments, the interposer includes two or more layers, and preferably includes a flexible top layer formed from a relatively thin sheet of material having a high elastic modulus and an additional "compliant bottom layer" formed from a material having a lower elastic modulus. See, for example, page 41, lines 29 *et seq.* and Fig. 13 depicting top layer 838 and compliant layer 840 beneath the top layer. As further explained in the specification, the compliant layer of the interposer may be provided together with the flexible top layer; may be provided separately from the top layer and positioned in place on the chip so that the top layer and compliant layer are brought together when the top layer is assembled to the chip (page 41, lines 19-22) or else may be formed by curing a material such as an elastomer in a position between the top layer and the chip (page 41, lines 29-35). In this regard, claims 67, 68, 69, 70, 71 and 73, which formerly referred to the compliant layer as a "compressible" layer have been amended thereto to correct the terminology and now refer to this layer as "layer of a compliant

material". This change makes the terminology used in these claims consistent with the terminology used in other claims, e.g., claim 2.


It is respectfully submitted that the \$112, first paragraph objection and rejection should be withdrawn in light of the foregoing comments.

New claim 81 has been added. Claim 81 depends from claim 77. Claim 77 in turn has been amended to depend, in the alternative, from claim 68 or claim 71. Claim 71 has been amended to correct lack of antecedent basis for the expression "said terminals". Claim 72 has been amended to correct its dependency. Claims 68 and 71 are directed to structures which include terminals overlying the "support structure", such as the "outside terminals", 8372 in Figs. 16 and 17, which overlie the "support element" 8307, and which also include a compliant layer disposed between the terminals and the support structure (Fig. 16, layer 8303). New claim 81 states that each of the terminals (the terminals overlying the support structure) is connected to the contact pad of the substrate by means of solder. As pointed out in the specification (page 45, lines 26-28), the so-called "outside terminals 8372" (Figs. 16 and 17) may be "bonded to contact pads on the substrate" in "substantially the same way as the assemblies discussed above", i.e., in substantially the same way as the other terminals discussed in the foregoing passages of the specification. Those foregoing passages in turn clearly describe the use of solder as a bonding material to connect the terminals of the chip assembly to the substrate. See e.g., the solder referred to at page 38, lines 4 et seq. Similarly, claim 76 has been amended to depend from claim 67 or claim 69. New claim 82, reciting the solder connection at the terminals to the substrate, has been added depending from claim 76. These claims are directed to structures which include terminals on the flexible element overlying the chip and supported by the compliant layer (Fig. 16, layer 8340).

It is respectfully submitted that the application is now in condition for allowance. If any issues remain, please telephone undersigned counsel to arrange for an interview. Attention is respectfully directed to the information disclosure statement dated March 1, 1996.

Respectfully submitted,

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